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Chow

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(54) **MULTIPLE USER ACCOUNTS FOR MANAGING STORED INFORMATION IN AN IMPLANTABLE MEDICAL DEVICE SYSTEM**

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G06F 21/31	(2013.01)

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USPC **726/17**

(58) **Field of Classification Search**

USPC 726/17

See application file for complete search history.

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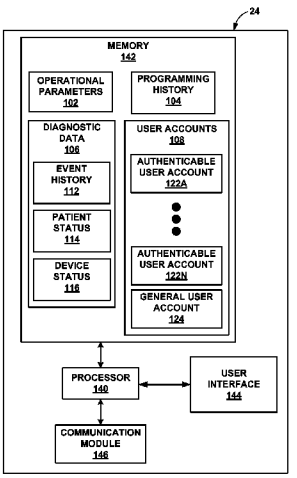
(57) **ABSTRACT**

Techniques for managing stored information in an implantable medical device system using multiple user accounts are described. An implantable medical device system may provide a general user account and a set of authenticable user accounts. In some examples, the general user account does not require a user of a programmer in an implantable medical device system to enter user identity information to manage information stored in the implantable medical device system. The general user account may be permitted to perform a subset of actions available to an authenticable user account. In some examples, an authenticable user account may rollback changes made to the stored information by the general user account. An authenticable user account may also be able to synchronize changes made to the stored information across all or some of the user accounts.

28 Claims, 9 Drawing Sheets



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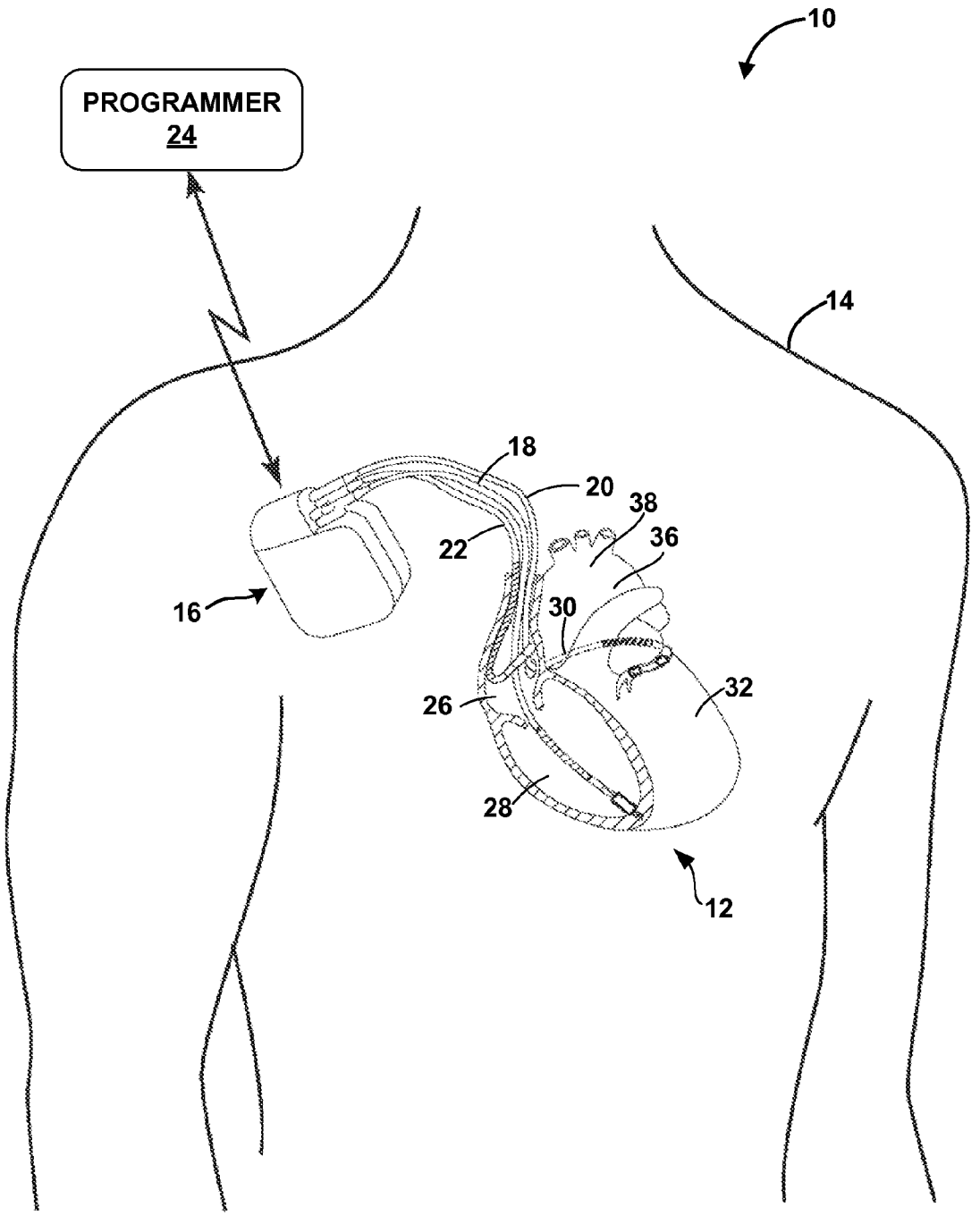

FIG. 1

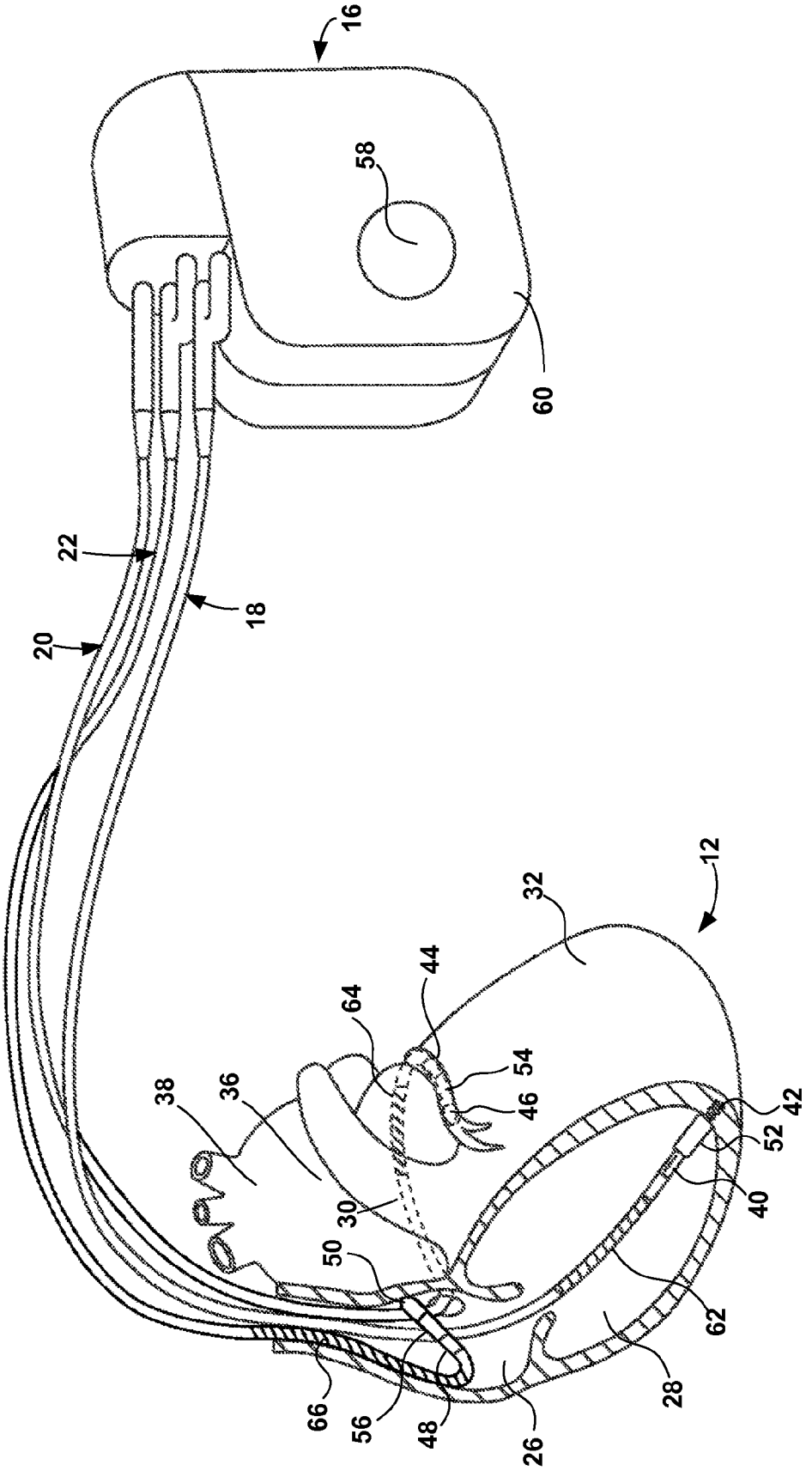
16
58
60
22
18
20
12
32
44
64
54
46
38
36
42
52
40
30
50
62
66
56
48
26
28

FIG. 2

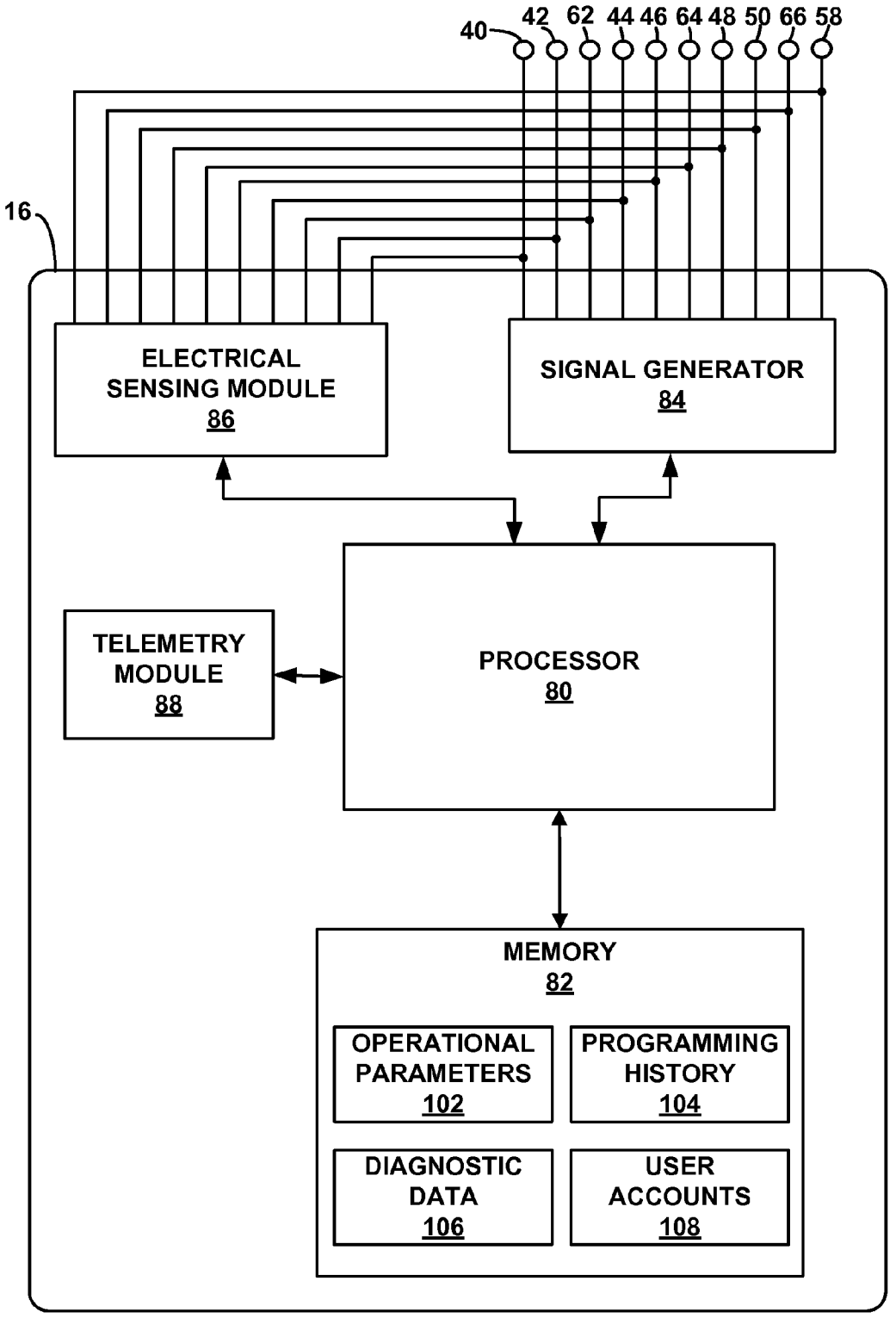
40
42
62
44
46
64
48
50
66
58
16
ELECTRICAL SENSING MODULE 86
SIGNAL GENERATOR 84
TELEMETRY MODULE 88
PROCESSOR 80
MEMORY 82
OPERATIONAL PARAMETERS 102
PROGRAMMING HISTORY 104
DIAGNOSTIC DATA 106
USER ACCOUNTS 108

FIG. 3

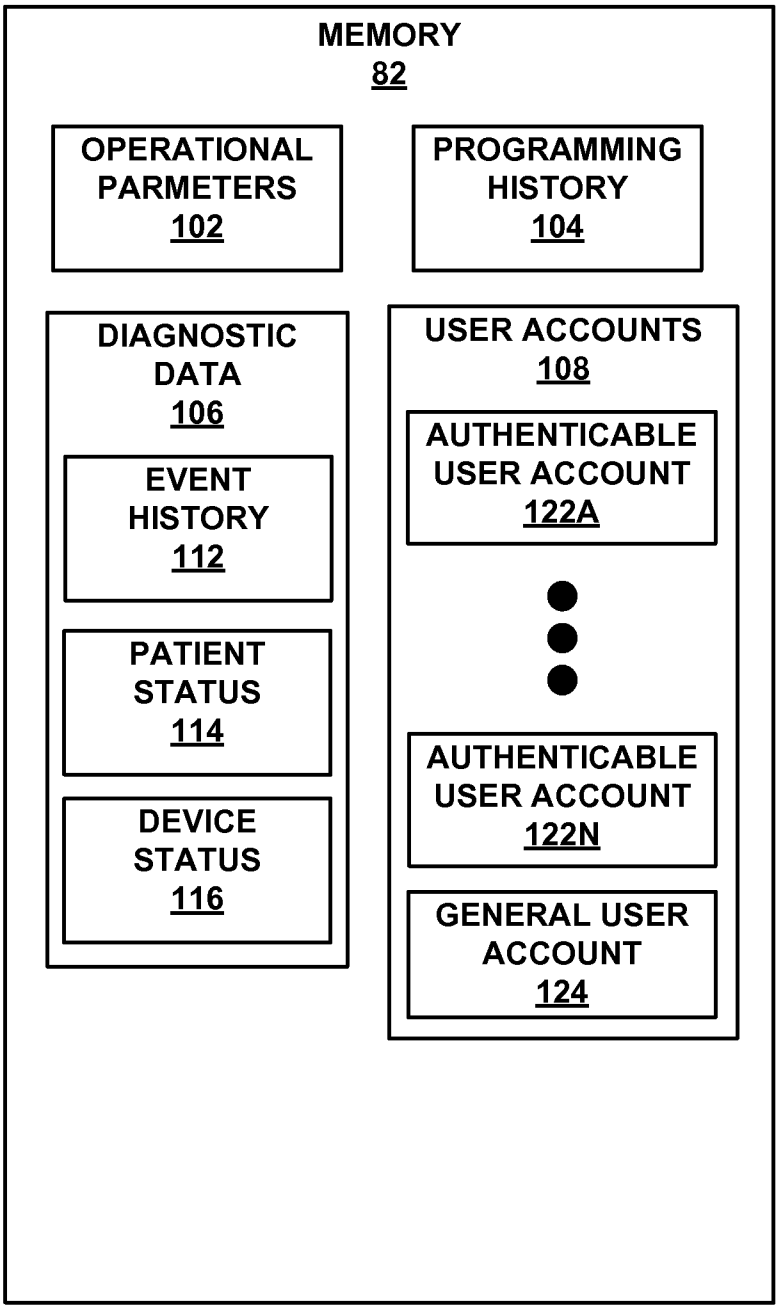
MEMORY
82
OPERATIONAL PARMETERS
102
PROGRAMMING HISTORY
104
DIAGNOSTIC DATA
106
EVENT HISTORY
112
PATIENT STATUS
114
DEVICE STATUS
116
USER ACCOUNTS
108
AUTHENTICABLE USER ACCOUNT
122A
AUTHENTICABLE USER ACCOUNT
122N
GENERAL USER ACCOUNT
124

FIG. 4

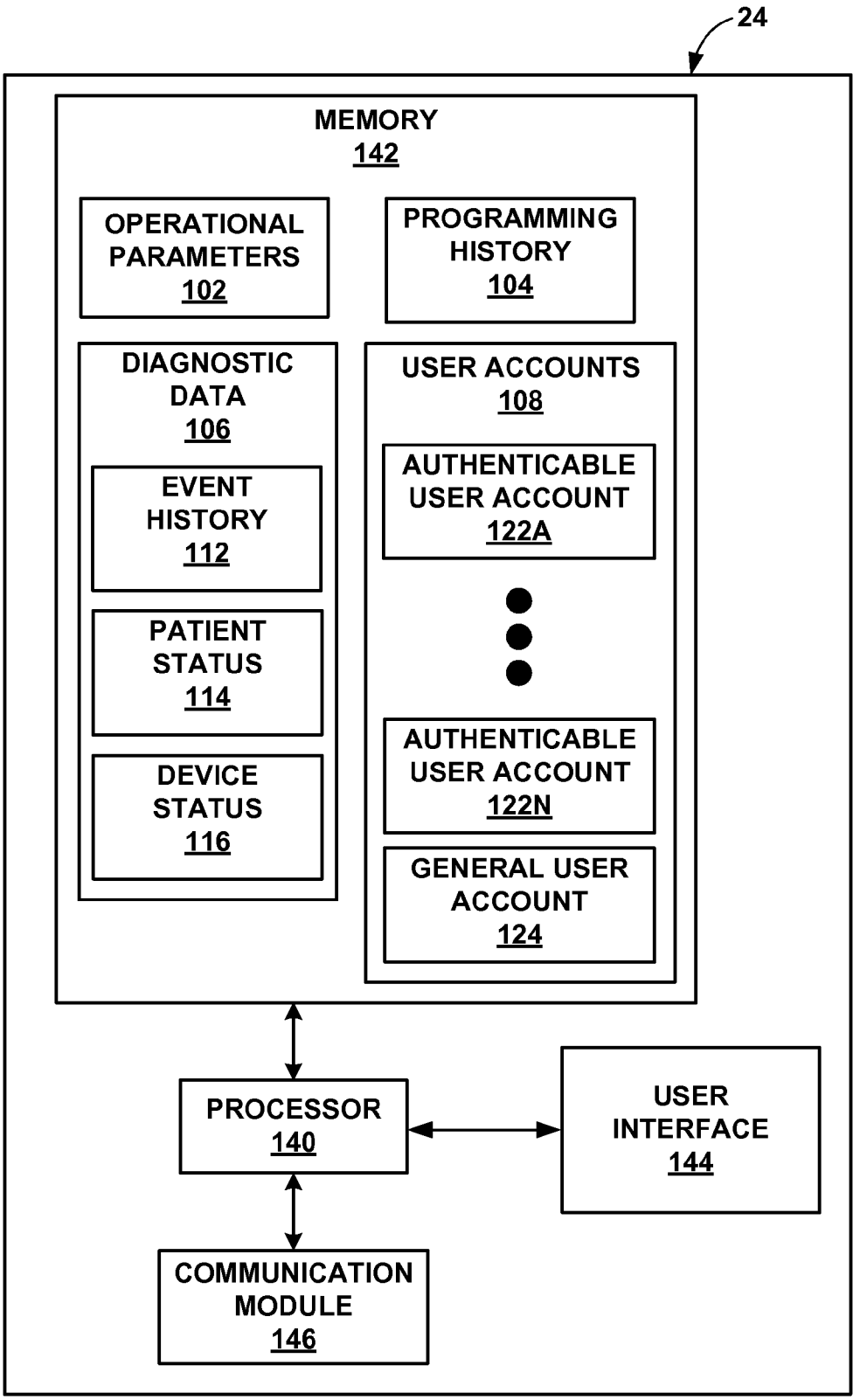
24
MEMORY
142
OPERATIONAL PARAMETERS
102
PROGRAMMING HISTORY
104
DIAGNOSTIC DATA
106
EVENT HISTORY
112
PATIENT STATUS
114
DEVICE STATUS
116
USER ACCOUNTS
108
AUTHENTICABLE USER ACCOUNT
122A
AUTHENTICABLE USER ACCOUNT
122N
GENERAL USER ACCOUNT
124
PROCESSOR
140
USER INTERFACE
144
COMMUNICATION MODULE
146

FIG. 5

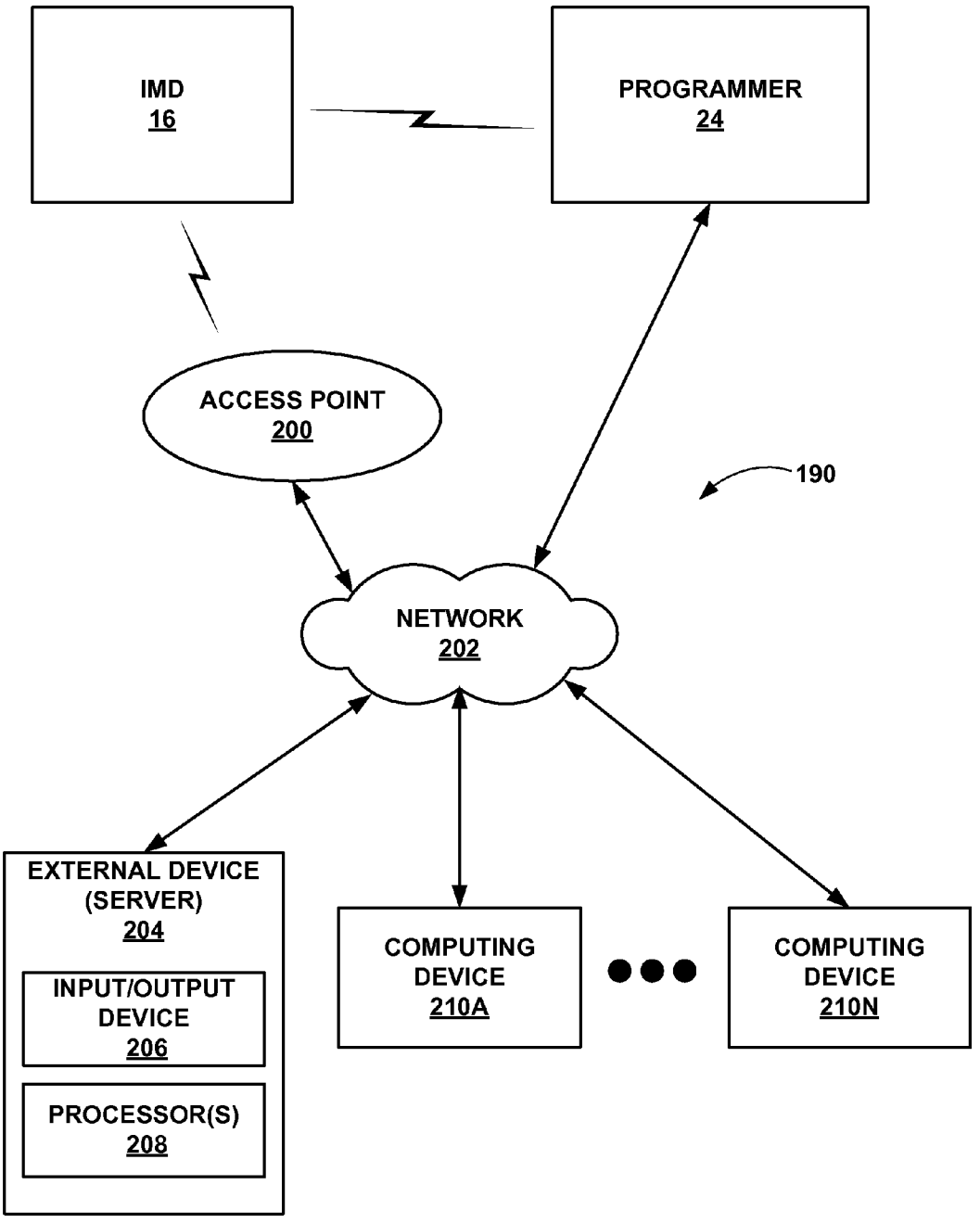
IMD
16
PROGRAMMER
24
ACCESS POINT
200
190
NETWORK
202
EXTERNAL DEVICE
(SERVER)
204
INPUT/OUTPUT
DEVICE
206
PROCESSOR(S)
208
COMPUTING
DEVICE
210A
COMPUTING
DEVICE
210N

FIG. 6

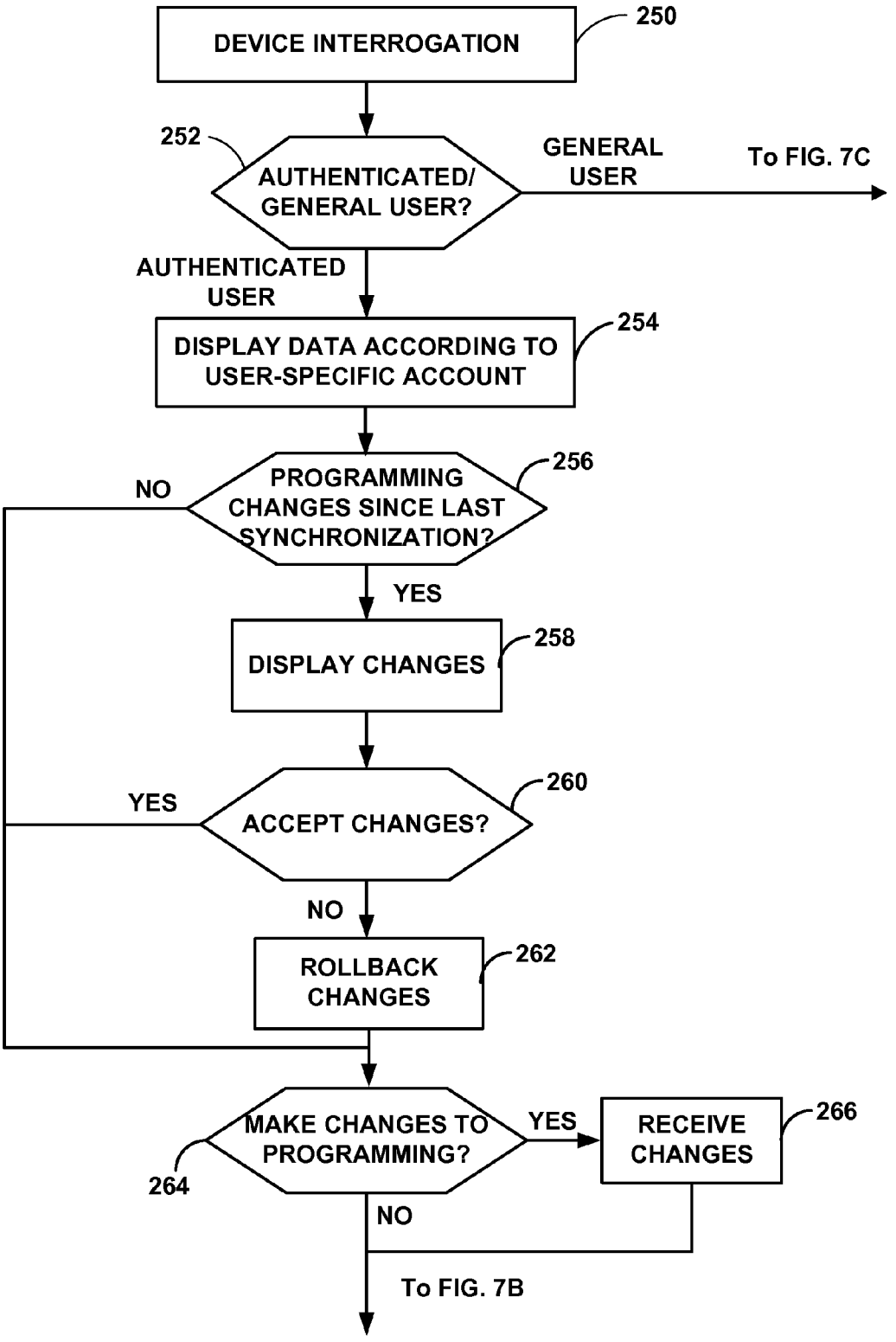
DEVICE INTERROGATION
250
252
AUTHENTICATED/ GENERAL USER?
GENERAL USER
To FIG. 7C
AUTHENTICATED USER
DISPLAY DATA ACCORDING TO USER-SPECIFIC ACCOUNT
254
PROGRAMMING CHANGES SINCE LAST SYNCHRONIZATION?
256
NO
YES
DISPLAY CHANGES
258
ACCEPT CHANGES?
260
YES
NO
ROLLBACK CHANGES
262
MAKE CHANGES TO PROGRAMMING?
264
YES
RECEIVE CHANGES
266
NO
To FIG. 7B

FIG. 7A

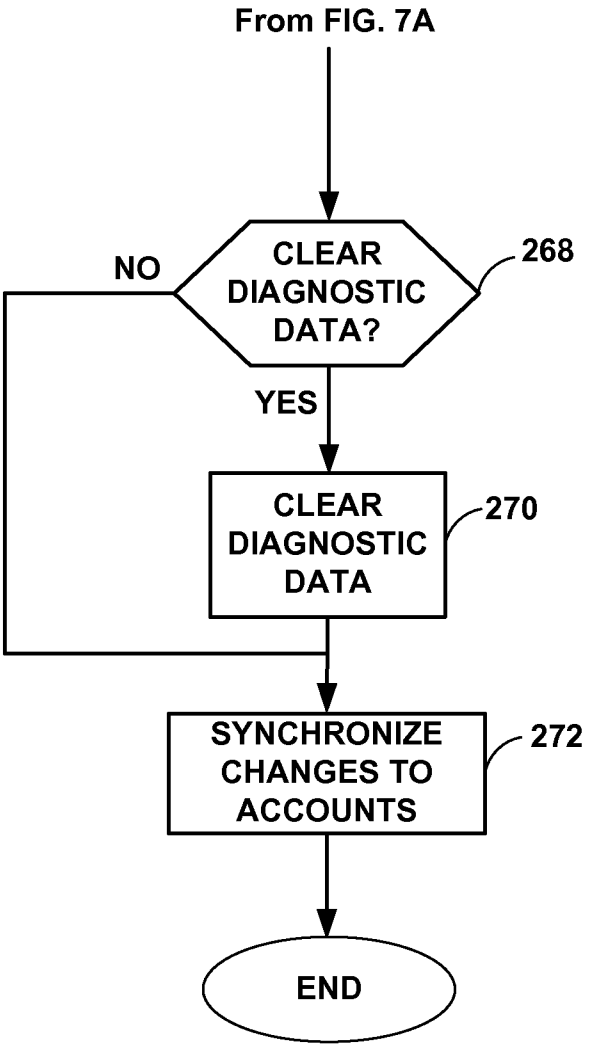
From FIG. 7A
CLEAR DIAGNOSTIC DATA?
268
NO
YES
CLEAR DIAGNOSTIC DATA
270
SYNCHRONIZE CHANGES TO ACCOUNTS
272
END

FIG. 7B

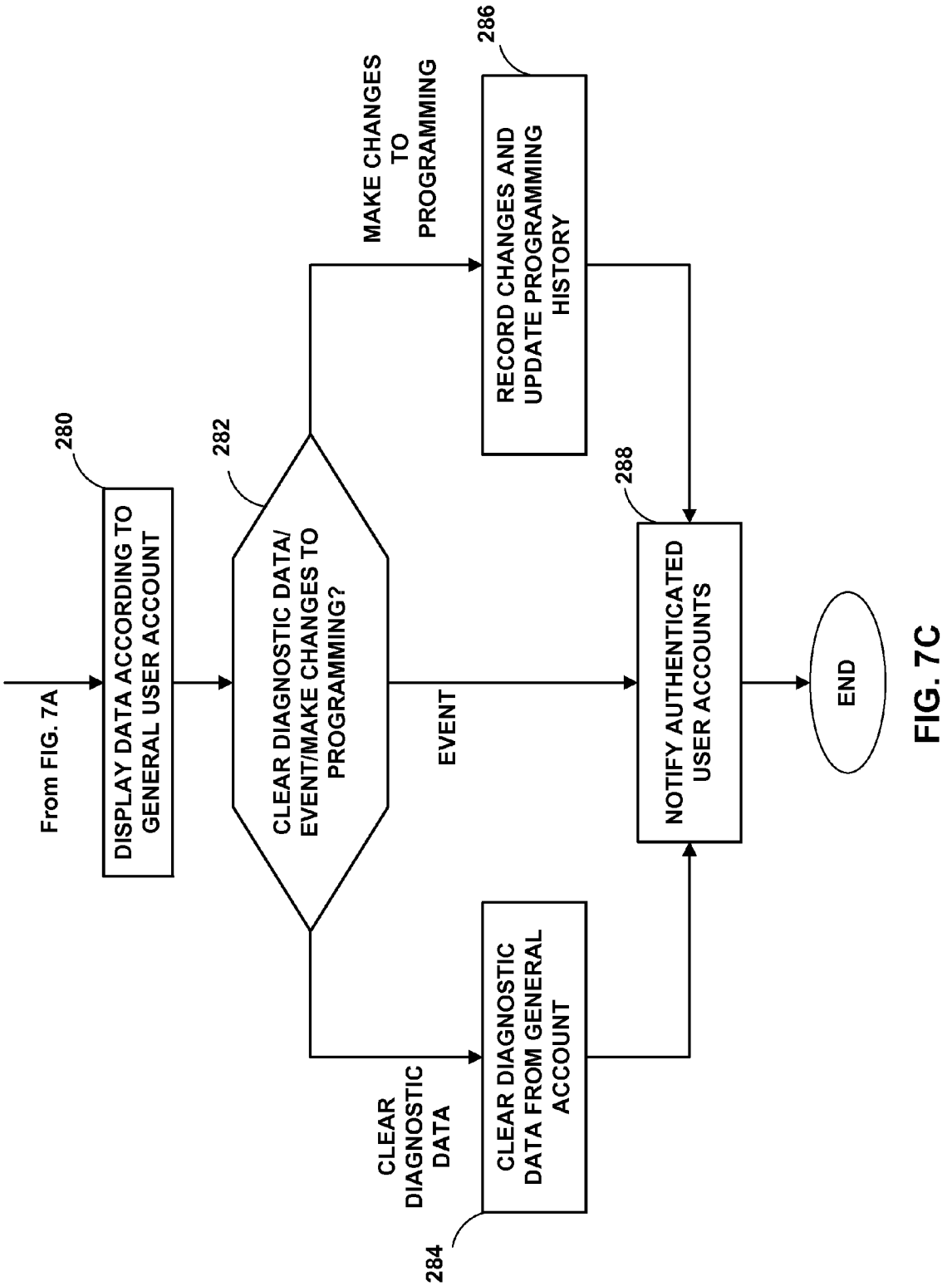
From FIG. 7A
280
DISPLAY DATA ACCORDING TO GENERAL USER ACCOUNT
282
CLEAR DIAGNOSTIC DATA/ EVENT/MAKE CHANGES TO PROGRAMMING?
MAKE CHANGES TO PROGRAMMING
286
RECORD CHANGES AND UPDATE PROGRAMMING HISTORY
EVENT
CLEAR DIAGNOSTIC DATA
284
CLEAR DIAGNOSTIC DATA FROM GENERAL ACCOUNT
288
NOTIFY AUTHENTICATED USER ACCOUNTS
END

FIG. 7C

MULTIPLE USER ACCOUNTS FOR MANAGING STORED INFORMATION IN AN IMPLANTABLE MEDICAL DEVICE SYSTEM

This application claims the benefit of U.S. Provisional Application No. 61/190,207, filed Aug. 27, 2008, the entire content of which is incorporated herein by reference.

TECHNICAL FIELD

This disclosure relates to medical device systems and, more particularly, systems including implantable medical devices.

BACKGROUND

A variety of implantable medical devices for delivering a therapy and/or monitoring a physiological condition have been clinically implanted or proposed for clinical implantation in patients. Implantable medical devices may deliver electrical stimulation or fluid therapy to and/or monitor conditions associated with the heart, muscle, nerve, brain, stomach or other organs or tissue. Examples of implantable medical devices include cardiac pacemakers, cardioverters, defibrillators, or devices combining two or more of these functions, which typically also monitor the electrical activity of the heart, and may also monitor other physiological parameters, such as activity, posture, or various vascular or cardiac flows or pressures.

Implantable medical devices may store a variety of information. For example, implantable medical devices may store information regarding the current operating parameters for the device that control the therapy delivery and patient monitoring functionality of the device, or changes made to these parameters over time. As another example, implantable medical devices may store diagnostic data, which may include monitored physiological parameters of the patient, or parameters of the device. The diagnostic data may also include information regarding events, such as the occurrence of a clinically significant patient event or the delivery of a responsive therapy. For example, an implantable medical device may store information regarding the occurrence of a tachyarrhythmia, e.g., including a corresponding electrogram and marker channel, and the delivery of a responsive therapy, such as a fibrillation pulse.

Implantable medical devices typically interact with a programmer that allows a user to manage information stored on the implantable medical device, e.g., change operation parameters or view information collected by the device. Various types of individuals may use a programmer including physicians, technicians, surgeons, electrophysiologists, or other clinicians. Conventional programmers and implantable medical devices provide any such user complete access and control over the stored information.

SUMMARY

Changes made to the information stored by an implantable medical device by one clinician using a programmer may not be obvious or apparent to another clinician who later accesses the implantable medical device using the same programmer or a different programmer. For example, a primary following clinician for a patient may be unaware of changes to the stored information made by some other clinician, such as a clinician at an emergency department of a hospital to which the patient was admitted in the case of an emergency. The changes made by the other clinician may be intentional or accidental, and may include clearing information collected by the implantable medical device since the last time the primary clinician interrogate the implantable medical device. The incomplete information presented to the primary clinician may lead to difficulty in diagnosing a medical problem by the primary clinician, as well as impaired medical treatment of the patient.

For example, if a patient presents to an emergency department because an implantable medical device improperly delivered a defibrillation pulse in response to sinus tachycardia, a clinician in the emergency department may reprogram the implantable medical device to remove a ventricular tachycardia zone, which may stop the implantable medical device from inappropriately delivering defibrillation pulses in response to sinus tachycardia. The emergency department clinician may also clear the information regarding the incorrect ventricular tachycardia detections and delivery of defibrillation pulses from the memory of the implantable medical device. When the patient later visits his or her principle following clinician, the different clinician may notice the programming change, but not the ventricular tachycardia episode that was cleared. The principle following clinician may reprogram the ventricular tachycardia zone, and the implantable medical device may subsequently deliver an inappropriate defibrillation pulse.

As another example, a primary clinician may optimize the atrioventricular delay or other aspects of the timing of cardiac resynchronization therapy provided by an implantable medical device. Another clinician may accidentally change the optimized setting, causing the patient to not feel well. The patient may return to the primary clinician, but the primary clinician may not notice the changed setting, and misattribute the reason for the patient not feeling well.

As another example, a primary clinician may decide to treat recurrent ventricular tachycardia in a patient who has an implantable medical device with amiodarone. An emergency department clinician may clear information regarding a subsequent long run of ventricular tachycardia that caused admission of the patient to the emergency department from the implantable medical device memory following interrogation of the implantable medical device. During a subsequent follow up visit, the primary clinician may interpret the lack of ventricular tachycardia episodes in the implantable medical device memory as evidence that the amiodarone was successful, and not change the therapy provided to the patient to address the breakthrough of ventricular tachycardia while the patient was on amiodarone.

In general, this disclosure is directed to techniques for managing information stored in an implantable medical device system by using multiple user accounts. The techniques may include authenticating a user of an implantable medical device system as a general user or as one of a set of authenticable users. In some examples, the general user may perform a subset of the actions that may be performed by an authenticable user, such as only being able to clear information from the general user account. In some examples, in response to changes made to the stored information by a general user, the implantable medical device system notifies the set of authenticable users of the changes.

In some examples, an authenticable user may review changes made by the general user, e.g., to the operational parameters of the implantable medical device, and undo or rollback those changes. An authenticable user may also make programming changes or review a programming history of the implantable medical device system. Furthermore, an authenticable user may synchronize any changes made while managing the stored information across one or more of the set of authenticable user accounts and the general user account.

In some examples, the stored information may be stored in memory of an implantable medical device or in memory of a programmer device. The stored information may also span memories of both devices. The stored information may comprise operational parameters for controlling the implantable medical device or a history of such operational parameters. In addition, the stored information may include diagnostic data such as, such as physiological data of the patient and events, such as the occurrence of a symptomatic event or the delivery of a responsive therapy. Examples of diagnostic data also include diagnostics of the device, such as a percent of pacing, mode switching information, which may also be useful to diagnosing the patient, as well as battery voltage, lead impedance, or short R-R interval sensing.

In one example, a method comprises storing data of an implantable medical device and a set of user accounts in a memory, wherein the set of user accounts comprises a general user account and a set of one or more authenticable user accounts, determining whether a user of a programmer that communicates with the implantable medical device is a general user or an authenticable user, and accessing one of the general user account or the set of authenticable user accounts based on the determination. Each of the accounts includes respective access control information that specifies a respective subset of the data of the implantable medical device available and respective actions available for managing the data. The method further comprises controlling access and management of the data of the implantable medical device by the user according to the access control information of the accessed one of the accounts.

In another example, a system comprises an implantable medical device, a programmer that communicates with the implantable medical device, a memory, and a processor. The memory stores data of the implantable medical device and a set of user accounts, wherein the set of user accounts comprises a general user account and a set of one or more authenticable user accounts. The processor determines whether a user of the programmer is a general user or an authenticable user, accesses one of the general user account or the set of authenticable user accounts in the memory based on the determination, wherein the each of the accounts include respective access control information that specifies a respective subset of the data of the implantable medical device available and respective actions available for managing the data, and controls access and management of the data of the implantable medical device by the user according to the access control information of the accessed one of the accounts.

In another example, a system comprises means for storing data of an implantable medical device and a set of user accounts in a memory, wherein the set of user accounts comprises a general user account and a set of one or more authenticable user accounts, means for determining whether a user of a programmer that communicates with the implantable medical device is a general user or an authenticable user, means for accessing one of the general user account or the set of authenticable user accounts based on the determination, wherein the each of the accounts include respective access control information that specifies a respective subset of the data of the implantable medical device available and respective actions available for managing the data, and means for controlling access and management of the data of the implantable medical device by the user according to the access control information of the accessed one of the accounts.

In another example, a computer-readable storage medium comprises instructions that cause a programmable processor to access data of an implantable medical device and a set of user accounts, wherein the set of user accounts comprises a general user account and a set of one or more authenticable user accounts, determine whether a user of a programmer that communicates with the implantable medical device is a general user or an authenticable user, access one of the general user account or the set of authenticable user accounts based on the determination, wherein the each of the accounts include respective access control information that specifies a respective subset of the data of the implantable medical device available and respective actions available for managing the data, and control access and management of the data of the implantable medical device by the user according to the access control information of the accessed one of the accounts.

The details of one or more examples are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the disclosure will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a conceptual drawing illustrating an example system that includes an implantable medical device (IMD) coupled to implantable medical leads and communicatively coupled to an external programmer.

FIG. **2** is a conceptual drawing illustrating the example IMD and leads of FIG. **1** in conjunction with a heart.

FIG. **3** is a functional block diagram illustrating an example configuration of the IMD of FIG. **1**.

FIG. **4** is a block diagram further illustrating information stored in a memory of the IMD shown in FIG. **3**.

FIG. **5** is a block diagram illustrating an example configuration of the external programmer shown in FIG. **1**.

FIG. **6** is a block diagram illustrating an example system that includes an external device, such as a server, and one or more computing devices that are coupled to the IMD and programmer shown in FIG. **1** via a network.

FIGS. **7**A-**7**C are flow diagrams illustrating an example method for controlling the management of information stored by a medical device system using multiple user accounts.

DETAILED DESCRIPTION

FIG. **1** is a conceptual diagram illustrating an example implantable medical device (IMD) system **10**. IMD system **10** includes an implantable medical device (IMD) **16**. IMD system **10** also include an external programmer **24** communicatively coupled to IMD **16**.

In the illustrated example, IMD **16** is a cardiac device that monitors and/or delivers therapy to heart **12**. IMD **16** may provide pacemaker, cardioverter and/or defibrillator functionality, as examples. For example, IMD **16** may be an implantable pacemaker-cardioverter-defibrillator. However, the disclosure is not limited to examples in which an IMD is a cardiac device. In other examples, an IMD may comprise an implantable neurostimulator, implantable pump, implantable loop recorder, or any other implantable medical device that delivers therapy to and/or monitors a patient.

In the illustrated example, IMD **16** is coupled to leads **18**, **20** and **22**. Leads **18**, **20** and **22** extend into the heart **12** of patient **14** to sense electrical activity of heart **12** and/or deliver electrical stimulation to heart **12**. In the example shown in FIG. **1**, right ventricular (RV) lead **18** extends through one or more veins (not shown), the superior vena cava (not shown), and right atrium **26**, and into right ventricle **28**. Left ventricular (LV) coronary sinus lead **20** extends through one or more

veins, the vena cava, right atrium **26**, and into the coronary sinus **30** to a region adjacent to the free wall of left ventricle **32** of heart **12**. Right atrial (RA) lead **22** extends through one or more veins and the vena cava, and into the right atrium **26** of heart **12**. The numbers, implant locations, and configurations of leads **18**, **20** and **22** in FIG. **1** are merely examples.

IMD **16** may sense electrical signals attendant to the depolarization and repolarization of heart **12** via electrodes (not shown in FIG. **1**) coupled to at least one of the leads **18**, **20**, **22**. In some examples, IMD **16** provides pacing pulses to heart **12** based on the electrical signals sensed within heart **12**. The configurations of electrodes used by IMD **16** for sensing and pacing may be unipolar or bipolar. IMD **16** may detect arrhythmia of heart **12**, such as tachycardia or fibrillation of ventricles **28** and **32**, and may also provide defibrillation therapy and/or cardioversion therapy via electrodes located on at least one of the leads **18**, **20**, **22**. In some examples, IMD **16** may be programmed to deliver a progression of therapies, e.g., defibrillation pulses with increasing energy levels, until a fibrillation of heart **12** is stopped.

Programmer **24** may take the form of a handheld computing device, computer workstation, or networked computing device, as examples. Programmer **24** may include a user interface that presents information to and receives input from a user. A user, such as a physician, technician, surgeon, electrophysiologist, or other clinician, may interact with programmer **24** to retrieve physiological or other diagnostic information from IMD **16**. A user may also interact with programmer **24** to program IMD **16**, e.g., select values for operational parameters of the IMD **16**.

For example, the user may use programmer **24** to retrieve diagnostic information from IMD **16** regarding the rhythm of heart **12**, trends therein over time, or tachyarrhythmic episodes. As another example, the user may use programmer **24** to retrieve information from IMD **16** regarding other sensed physiological parameters of patient **14**, such as intracardiac or intravascular pressure, activity, posture, respiration, or thoracic impedance. As another example, the user may use programmer **24** to retrieve information from IMD **16** regarding delivery of therapy by IMD **16**, such as the time and characteristics of delivered defibrillation or cardioversion pulses, information regarding times when IMD **16** automatically switched from one pacing mode to another, i.e., mode switching, and information regarding the degree to which the patient was paced, e.g., percent pacing, which may be significant for evaluating the efficacy of cardiac resynchronization therapy. As another example, the user may use the programmer **24** to retrieve information from IMD **16** regarding the performance or integrity of IMD **16** or other components of system **10**, such as leads **18**, **20** and **22**, or a power source of IMD **16**.

The user may use programmer **24** to program a therapy progression, select electrodes used to deliver defibrillation pulses, select waveforms for the defibrillation pulse, or select or configure a fibrillation detection algorithm for IMD **16**. The user may also use the programmer **24** to program aspects of other therapies provided by IMD **16**, such as cardioversion or pacing therapies. In some examples, a user may be required enter user identity information into the programmer **24** before being permitted to interact with the programmer **24** and the IMD **16**. If the user elects not to enter user identity information, the user may only have the ability to perform a certain, reduced number of features the user would otherwise be able to perform.

IMD **16** and programmer **24** may communication via wireless communication using any techniques known in the art. Examples of communication techniques may include, for example, low frequency or radiofrequency (RF) telemetry, but other techniques are also contemplated. In some examples, programmer **24** may include a programming head that may be placed proximate to the patient's body near the IMD **16** implant site in order to improve the quality or security of communication between IMD **16** and programmer **24**.

FIG. **2** is a conceptual diagram illustrating IMD **16** and leads **18**, **20**, and **22** of system **10** in greater detail. Leads **18**, **20** and **22** include conductors that are electrically coupled to a stimulation generator and an electrical sensing module (FIG. **3**) within a housing **60** of IMD **16**. The conductors are also coupled to electrodes on the leads.

Bipolar electrodes **40** and **42** are located adjacent to a distal end of lead **18** in right ventricle **28**. In addition, bipolar electrodes **44** and **46** are located adjacent to a distal end of lead **20** in coronary sinus **30** and bipolar electrodes **48** and **50** are located adjacent to a distal end of lead **22** in right atrium **26**. Leads **18**, **20**, **22** also include elongated electrodes **62**, **64**, **66**, respectively, which may take the form of a coil. There are no electrodes located in left atrium **36**, but other examples may include electrodes in left atrium **36**. Furthermore, other examples may include electrodes in other locations, such as the aorta or a vena cava, or epicardial or extracardial electrodes proximate to any of the chambers or vessels described herein. Each of the electrodes **40**, **42**, **44**, **46**, **48**, **50**, **62**, **64**, and **66** may be electrically coupled to a respective conductor within the lead body of its associated lead **18**, **20**, **22**, and thereby coupled to the stimulation generator and sensing module within housing **60** of IMD **16**.

In some examples, as illustrated in FIG. **2**, IMD **16** includes one or more housing electrodes, such as housing electrode **58**, which may be formed integrally with an outer surface of hermetically-sealed housing **60** of IMD **16** or otherwise coupled to housing **60**. In some examples, housing electrode **58** is defined by an uninsulated portion of an outward facing portion of housing **60** of IMD **16**. Other division between insulated and uninsulated portions of housing **60** may be employed to define two or more housing electrodes. In some examples, housing electrode **58** comprises substantially all of housing **60**. Housing electrode **58** is also coupled to one or both of the stimulation generator and sensing module within housing **60** of IMD **16**.

IMD **16** may sense electrical signals attendant to the depolarization and repolarization of heart **12** via electrodes **40**, **42**, **44**, **46**, **48**, **50**, **62**, **64** and **66**. The electrical signals are conducted to IMD **16** from the electrodes via the respective leads **18**, **20**, **22**. IMD **16** may sense such electrical signals via any bipolar combination of electrodes **40**, **42**, **44**, **46**, **48**, **50**, **62**, **64** and **66**. Furthermore, any of the electrodes **40**, **42**, **44**, **46**, **48**, **50**, **62**, **64** and **66** may be used for unipolar sensing in combination with housing electrode **58**.

In some examples, IMD **16** delivers pacing pulses via bipolar combinations of electrodes **40**, **42**, **44**, **46**, **48** and **50** to produce depolarization of cardiac tissue of hear **12**. In some examples, IMD **16** delivers pacing pulses via any of electrodes **40**, **42**, **44**, **46**, **48** and **50** in combination with housing electrode **58** in a unipolar configuration. Furthermore, IMD **16** may deliver defibrillation pulses to heart **12** via any combination of elongated electrodes **62**, **64**, **66**, and housing electrode **58**. Electrodes **58**, **62**, **64**, **66** may also be used to deliver cardioversion pulses to heart **12**.

FIG. **3** is a functional block diagram illustrating one example configuration of IMD **16**. In the illustrated example, IMD **16** includes a processor **80**, memory **82**, signal generator **84**, electrical sensing module **86** and telemetry module **88**. Memory **82** includes computer-readable instructions that, when executed by processor **80**, cause IMD **16** and processor **80** to perform various functions attributed to IMD **16** and

processor **80** herein. These computer-readable instructions may include operational parameters **102**, sometimes referred to as a program or programs, that control the way the IMD **16** operates. Memory **82** may store a history of the operational parameters **102** used in controlling the IMD **16** at various times during the operation of IMD **16** in a programming history **104**.

In addition, memory **82** may store any information sensed by any electrode or any combination of electrodes **40**, **42**, **44**, **46**, **48**, **50**, **62**, **64** and **66**, including information stored in the form of a cardiac electrogram (EGM), as diagnostic data **106**. In some examples, IMD **16** comprises other sensors, such as a patient activity, motion and/or posture sensor, which may take the form of one or more accelerometers, a cardiac or vascular blood pressure sensor, a blood flow sensor, a blood oxygen sensor, or a respiration sensor. Memory **82** may store information regarding such physiological parameters of patient **14** monitorable by such sensors, e.g., values or trends of such physiological parameters, as diagnostic data **106**. In some examples, memory **82** stores information regarding clinically significant events and/or therapeutic responses, such as tachyarrhythmias and responsive defibrillation pulses, as diagnostic data **106**. Diagnostic data **106** may assist a user of programmer **24** in diagnosing and treating a patient **14**. Memory **82** may also store user identity information corresponding to user accounts **108**. Memory **82** may include any volatile, non-volatile, magnetic, optical, or electrical media, such as a random access memory (RAM), read-only memory (ROM), non-volatile RAM (NVRAM), electrically-erasable programmable ROM (EEPROM), flash memory, or any other digital or analog media.

Processor **80** may include any one or more of a microprocessor, a controller, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or equivalent discrete or analog logic circuitry. In some examples, processor **80** may include multiple components, such as any combination of one or more microprocessors, one or more controllers, one or more DSPs, one or more ASICs, or one or more FPGAs, as well as other discrete or integrated logic circuitry. The functions attributed to processor **80** herein may be embodied as software, firmware, hardware or any combination thereof.

Processor **80** controls signal generator **84** to deliver stimulation therapy to heart **12** according to operational parameters **102**. For example, processor **80** may control stimulation generator **84** to generate electrical pulses with the amplitudes and pulse widths specified by operational parameters **102**, and deliver the electrical pulses to the combination of electrodes **40**, **42**, **44**, **46**, **48**, **50**, **58**, **62**, **64** and **66** specified by operational parameters **102** (and thereby to a specified chamber of heart **14**) with the electrode polarities specified by operational parameters **102**. In some examples, processor **80** controls delivery of pacing pulses in response to a sensed depolarization and/or expiration of a timer according to any of a variety of known single or multiple chamber pacing modes as specified by operational parameters **102**, and controls delivery of pacing, cardioversion and defibrillation pulses in response to a detected tachyarrhythmia in accordance with parameters and/or a therapy progression specified by operational parameters **102**. In some examples, processor **80** automatically switches pacing modes in response to a sensed event, and information regarding such mode switching may be stored as diagnostic data **106**.

Signal generator **84** is electrically coupled to electrodes **40**, **42**, **44**, **46**, **48**, **50**, **58**, **62**, **64** and **66**, e.g., via conductors of the respective lead **18**, **20**, **22** or, in the case of housing electrode **58**, via an electrical conductor disposed within housing **60** of IMD **16**. Signal generator **84** is configured to generate and deliver electrical stimulation therapy to heart **12**. In some examples, signal generator **84** delivers pacing, cardioversion, or defibrillation stimulation in the form of electrical pulses. In other examples, signal generator **84** may deliver one or more of these types of stimulation in the form of other signals, such as sine waves, square waves, or other substantially continuous time signals.

Signal generator **84** may include a switch module and processor **80** may use the switch module to select, e.g., via a data/address bus, which of the available electrodes are used to deliver defibrillation pulses or pacing pulses. The switch module may include a switch array, switch matrix, multiplexer, or any other type of switching device suitable to selectively couple stimulation energy to selected electrodes.

Electrical sensing module **86** monitors signals from at least one of electrodes **40**, **42**, **44**, **46**, **48**, **50**, **58**, **62**, **64** or **66** in order to monitor electrical activity of heart **12**. Electrical sensing module **86** may also include a switch module to select which of the available electrodes are used to sense the heart activity. In some examples, electrical sensing module **86** includes multiple detection channels, each of which may be selectively coupled to respective combinations of electrodes **40**, **42**, **44**, **46**, **48**, **50**, **58**, **62**, **64** or **66** to detect electrical activity of a particular chamber of heart **12**. Each detection channel may comprise an amplifier that outputs an indication to processor **80** in response to detection of an event, such as a depolarization, in the respective chamber of heart **12**.

Processor **80** controls delivery of stimulation by signal generator **84** based on the indications received from electrical sensing module **86**, or the absence of such indications, as is known in the art. Processor **80** may also detect tachyarrhythmias based on the rate of such indications, as is known in the art. Processor **80** may store information regarding heart rate, R-R intervals, and other information derived from the indications from sensing module **86**, in memory **82** as diagnostic data **106**.

In some examples, sensing module **86** comprises a channel that provides a signal sensed via a combination of the electrodes to an analog-to-digital converter (not shown), which provides a digitized signal to processor **80**. Processor **80** may analyze the signal, e.g., for tachyarrhythmia detection, and/or store the signal in memory **82** as an EGM. In some examples, EGMs are stored with a marker channel that indicates time correlated events, such as depolarizations detected by sensing module **86**, detection of a tachyarrhythmia, and delivery of a responsive therapy, e.g., defibrillation pulse. EGMs and marker channels may be stored as diagnostic data **106** in memory **82**. Operational parameters **102** may include information specifying the amplification, blanking or filtering of channels of sensing module **86**, as well as the storage of diagnostic data **106** by processor **80**.

Telemetry module **88** includes any suitable hardware, firmware, software or any combination thereof for communicating with another device, such as programmer **24** (FIG. **1**). Under the control of processor **80**, telemetry module **88** may receive downlink telemetry from and send uplink telemetry to programmer **24** with the aid of an antenna, which may be internal and/or external. Processor **80** may provide data to be uplinked to programmer **24** and receive data from programmer **24** via telemetry module **88**.

FIG. **4** is a block diagram further illustrating memory **82**. As illustrated by FIG. **4**, diagnostic data **106** may comprise an event history **112**, patient status information **114**, and device status information **116**. Event history **112**, for example, is comprised of various types of events such as ventricular tachycardia (VT) episodes, ventricular fibrillation (VF) epi-

sodes, atrial fibrillation (AF) episodes, decompensation events, pacing mode switches by IMD **16**, or responsive therapies delivered by IMD **16**. In an example in which an IMD comprises an implantable pump, event history **112** may include automatic delivery of bolus by IMD **16** or patient **14** initiated delivery of bolus. Patient status information **114** may comprise any of various types of indicators of patient status, such as physiological parameter values or trends, heart failure indices, patient activity history, or heart rate variability, which aid in evaluating the health status of patient **14**. Device status information **116** may comprise indicators of the performance of IMD **16** or other components of system **10**, such as leads **18**, **20** and **22**, or a power source of IMD **16**. Examples of device status information **116** include lead impedance measurements or trends, percent biventricular pacing, or numbers or frequencies of detected short R-R intervals, which may be non-physiologic.

User accounts **108** of memory **82** may include a general user account **124** which may not require a user of programmer **24** to enter user identity information before permitting the user to interact with programmer **24** and IMD **16**. User accounts **108** also include a set of authenticable user accounts, **122**A to **122**N. Processor **80** may execute computer-readable instructions stored in memory **82** which cause the processor to receive user identity information from programmer **24**, compare the user identity information to user accounts **108** stored in memory **82**, and generate access control information. The user identity information may comprise, for example, a user name and password. The access control information specifies actions available to the user for managing any or all of the information stored in memory **82**. The access control information may also specify how the user of the programmer **24** is permitted to interact with the programmer **24** and/or IMD **16**.

The access control information may be applied by processor **80** when determining what information to provide programmer **24** via telemetry module **88** or how respond to commands from programmer **24**. In some examples, processor **80** provides the access control information to programmer **24** via telemetry module **88**. Programmer **24** may apply the access control information received from IMD **16** to control the actions made available to the user of programmer for interacting with IMD **16** and managing the information stored in memory **82** of IMD **16**.

In one example, the user of programmer **24** may elect to enter user identity information corresponding to general user account **124**. If the user elects not to enter user identity information, programmer **24** behaves as if the user entered user identity information corresponding to general user account **124**. In either case, the user is considered an unauthenticated user. Processor **80** generates access control information corresponding to general user account **124** which specifies actions available to the unauthenticated user for managing stored information.

When processor **80** and/or programmer **24** applies this access control information, for example, the unauthenticated user is able perform various actions including clearing diagnostic data **106** from general user account **124**. After the unauthenticated user clears diagnostic data **106** form general user account **124**, diagnostic data **106** is not cleared from memory **82** and is still viewable by one or more of the set of authenticable user accounts **122**A to **122**N. In other examples, the unauthenticated user is permitted to change operational parameters **102** to alter the therapy delivered by IMD **16**, and processor **80** may then update programming history **104** to reflect the changes made to operational parameters **102**. The unauthenticated user may also view programming history **104**. However, the unauthenticated user may not be permitted to synchronize programming changes across the set of authenticable user accounts **122**A to **122**N or clear programming history **104** from memory **82**.

After the unauthenticated user performs any action, such as changing operational parameters **102**, a notification may be sent to one or more of the set of authenticable user accounts **122**A to **122**N. Notification of the authenticable user or users may comprise storing an indication that the data was cleared in the account **122**, or by communication with a server **204** or computing device **210** (of FIG. **6**) via a network **202** (of FIG. **6**). As examples, the authenticable user may receive the notification via the user interface **144** (of FIG. **5**) of programmer **24** the next time the authenticable user accesses the programmer **24**, via an email or web account, via a cellular phone or personal digital assistant, or by fax.

In another example, the user of programmer **24** elects to enter user identity information and the user identity information does not match the user identity information stored in any authenticable user account **122**A to **122**N. In this example, the user is not permitted to interact with programmer **24** or IMD **16** through an authenticable user account. However, the user may be permitted to interact with programmer **24** and IMD **16** through general user account **124** as described above.

In another example, the user of programmer **24** enters user identity information and the user identity information matches the user identity information stored in one of the set of authenticable user accounts **122**A to **122**N. Once processor **80** executes computer-readable instructions which cause processor **80** to match the user identity information with an authenticable user account, the user is considered an authenticated user. The set of authenticable user accounts **122**A to **122**N may have the same or different access control information associated with each individual authenticable user account. Processor **80** generates access control information corresponding to the matching authenticable user account. When processor **80** and/or programmer **24** applies this access control information, for example, the authenticated user may be permitted to perform such actions as clearing event history **112** from being viewable by general user account **124** or the user's authenticable user account. In other examples, the authenticated user may be permitted to clear event history **112** from memory **82** such that it is not viewable by general user account **124** or by any of the set of authenticable user accounts **122**A to **122**N.

In other examples, the authenticated user is permitted to make programming changes to operational parameters **102** and synchronize the programming changes across general user account **124** and one or more of the set of authenticable user accounts **122**A to **122**N. Processor **80** updates programming history **104** to reflect the programming changes made to operational parameters **102**.

In further examples, processor **80** and/or programmer **24** applying the access control information results in the authenticated user being permitted to review the changes made by an unauthenticated user since the last time the authenticated user interrogated programmer **24** or IMD **16**. For example, the authenticated user may view changes to operational parameters **102** in programming history **104**. After reviewing the changes, the authenticated user may synchronize the changes across all user accounts **108**. If the authenticated user does not approve of the changes, the authenticated user may elect to rollback the changes such that programmer **24** and IMD **16** are reset to the state prior to when the unauthenticated user made the changes. The authenticated user may make changes to operational parameters **102**, and clear diagnostic data **106** or any portion of diagnostic data **106** from memory **82**.

In some examples, the authenticated user is permitted to program the access control information corresponding to the general user account **124** to control which device features an unauthenticated user may adjust, clear or otherwise program. For example, the authenticated user may program the access control information corresponding to the general user account **124** such that when processor **80** and/or programmer **24** applies the access control information to an unauthenticated user, the unauthenticated user is not permitted to change operational parameters **102** to alter the therapy delivered by IMD **16** or clear diagnostic data **106** from general user account **124**.

In another example, the authenticated user is permitted to program IMD **16** and/or programmer **24** to control what actions taken by an unauthenticated user generate a notification for one or more of the set of authenticated user accounts as described above. For example, the authenticated user may program IMD **16** to generate a notification any time an unauthenticated user makes changes to the operational parameters **102**, but not generate a notification when an unauthenticated user clears the diagnostic data **106**. The authenticated user may also be permitted to select what type or types of notification are provided for each of a plurality of particular actions by the unauthenticated user.

In addition to the notification to the authenticated user, in some examples, the authenticated user may select or enter an alert or message to be provided to any unauthenticated user in response to actions of the unauthenticated user when interacting with programmer **24** or IMD **16**. The alert or message, such as a text message on a display of programmer **24**, may be provided by programmer **24** in response to any interaction with programmer **24**, or certain actions of the unauthenticated user, such as changing operation parameters **102** or clearing diagnostic data **106**. The authenticated user may select what type or types of alerts or messages are provided to the unauthenticated user for each of a plurality of particular actions by the unauthenticated user.

As described above, an unauthenticated user may clear data from programming history **104** a diagnostic data **106** for the general user account **124**, but not for one or more authenticable user accounts **122**. An authenticable user may clear data from programming history **104** a diagnostic data **106** for that user's account **122**, as well as the general user account **124**, and in some cases for other authenticable user accounts **122**. Clearing data herein may refer to changing a flag or other indication in an account **122** or **124** such that the user or users associated with the account are no longer able to access the data, rather than deleting the data from memory **142**. In some examples, however, an authenticable user may clear programming history **104** and diagnostic data **106** such that it is deleted from memory **82**.

It is contemplated and understood that when processor **80** and/or programmer **24** applies access control information, the user interacting with programmer **24** and IMD **16** through general user account **124** or one of the set of authenticable user accounts **122**A to **122**N may be restricted from managing operational parameters **102**, programming history **104**, diagnostic data **106** or user accounts **108** in many other ways and in different combinations of ways in addition to the examples described above.

FIG. **5** is a functional block diagram illustrating an example configuration of programmer **24**. In general, programmer **24** comprises a computing device. In the example shown in FIG. **5**, programmer **24** includes a processor **140**, memory **142**, user interface **144** and communication module **146**. Programmer **24** may comprise a dedicated hardware device with dedicated software for programming of IMD **16**. Alternatively, programmer **24** may comprise an off-the-shelf computing device running an application that enables programmer **24** to program IMD **16**. For example, programmer **24** may comprise a workstation computer, a laptop computer, a hand-held device such as a personal digital assistant (PDA), a cellular phone or smart phone, or other devices.

A clinician or other user interacts with programmer **24** via user interface **144**, which may include a display to present a graphical user interface to a user, and a keypad, mouse, light pen, stylus, microphone for voice recognition, or other mechanism(s) for receiving input from a user. In some examples, processor **140** retrieves an operational parameters **102**, programming history **104**, and diagnostic data **106** from IMD via communication module **146**, and controls user interface **144** to present graphical and/or textual representations of the data.

Processor **140** can take the form of one or more microprocessors, DSPs, ASICs, FPGAs, programmable logic circuitry, or the like, and the functions attributed to processor **140** herein may be embodied as hardware, firmware, software or any combination thereof. Memory **142** may store instructions that cause processor **140** to provide the functionality ascribed to programmer **24** herein, and information used by processor **140** to provide the functionality ascribed to programmer **24** herein. Memory **142** may include any fixed or removable magnetic, optical, or electrical media, such as RAM, ROM, CD-ROM, hard or floppy magnetic disks, EEPROM, or the like. Processor **140** may include any one or more of a microprocessor, a controller, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or equivalent discrete or analog logic circuitry.

Memory **142** may store operational parameters **102**, programming history **104**, diagnostic data **106**, and user accounts **108** retrieved from IMD **16**. Any combination or portion of operational parameters **102**, programming history **104**, diagnostic data **106** and user accounts **108** may be stored in memory **82** of IMD **16**, memory **142** of programmer **24**, or both.

Programmer **24** may communicate wirelessly with IMD **16**, such as by using RF communication or proximal inductive interaction. This wireless communication is possible through the use of communication module **146**, which may be coupled to an internal antenna or an external antenna (not shown). Communication module **142** may also be configured to communicate with another computing device via wireless communication techniques, or direct communication through a wired connection. Examples of local wireless communication techniques that may be employed to facilitate communication between programmer **24** and another computing device include RF communication according to the 802.11 or Bluetooth specification sets, infrared communication, e.g., according to the IrDA standard, or other standard or proprietary telemetry protocols. In this manner, other external devices may be capable of communicating with programmer **24** without needing to establish a secure wireless connection. An additional computing device in communication with programmer **24** may be a networked device such as a server capable of processing information retrieved from IMD **16**. An example of such an arrangement is discussed with respect to FIG. **6**.

Processor **140** of programmer **24** may generate and apply access control information as described with respect to processor **80** of IMD **16**. Accordingly, in one example, programmer **24** interrogates IMD **16** and retrieves user identity information corresponding to user accounts **108** of IMD **16** and stores the information in memory **142**. Processor **140** com-

pares user identity information entered by the user and received via user interface **144** to the user identity information stored in the set of authenticable user accounts **122**A to **122**N and to the user identity information stored in general user account **124**. If the entered user identity information matches one of the set of authenticable user accounts, the user is an authenticated user. If the user identity information matches general user account **124**, the user is an unauthenticated user. Again, in some examples, the user is allowed to interact with programmer **24** and IMD **16** as an unauthenticated user without entering any user identity information, e.g., interaction as a general user is a default state of programmer **24** and/or IMD **16**. In another example, programmer **24** stores user accounts **108** in memory **142** and processor **140** performs the comparison described above without interrogating IMD **16**. In another example, programmer **24** transmits the user identity information entered by the user to IMD **16** and processor **80** of IMD **16** compares the entered user identity information to user accounts **108** as described above.

In some examples, processor **140** generates access control information as described above with respect to processor **80** of IMD **16**. In such examples, where the user is an unauthenticated user, processor **140** generates access control information corresponding to general user account **124** and processor **140** applies the access control information to specify actions available to the unauthenticated user for managing information stored in memory **142**. The actions available to the unauthenticated user include at least those described above. For example, the unauthenticated user may be provided with an action to clear diagnostic data **106** from programmer **24** or IMD **16** such that the diagnostic data is no longer displayed to the unauthenticated user. Other examples include actions which permit the unauthenticated user to make changes to programming, but which do not permit the unauthenticated user to synchronize those changes across the set of authenticable user accounts **122**A to **122**N.

The unauthenticated user may be permitted to interrogate IMD **16** and cause IMD **16** to transmit any or all of the information stored in memory **82** (FIG. **4**) to memory **142** of programmer **24**. After programmer **24** receives information from IMD **16**, processor **140**, for example, may execute computer-readable instructions which analyze the information received from IMD **16** and notify the users associated with one or more user accounts of the set of authenticable user accounts **122**A to **122**N if event history **112** contains one or more events. In another example, processor **140** detects that an unauthenticated user made changes to the operational parameters **102** or cleared diagnostic data **106** and, in response, notifies one or more users associated with one or more user accounts of the set of authenticable user accounts **122**A to **122**N.

Where the user is an authenticated user, processor **140** generates access control information corresponding to the corresponding one of the set of authenticable user accounts **122**A to **122**N and applies the access control information to specify actions available to the user for managing information stored in memory **142**. The actions available to the authenticated user include at least those described above. For example, the authenticated user may clear diagnostic data **106** from memory **142** of programmer **24** such that no authenticated user or unauthenticated user may perform an action to display diagnostic data **106**, which in some cases may include deleting the diagnostic data from memory **142**. In some examples, the actions performed by authenticated and unauthenticated users on operational parameters **102**, programming history **104**, and diagnostic data **106** may initially modify the data stored in memory **142** of programmer **24**, which may provide commands to IMD **16** to made corresponding modifications to the data stored in memory **82**, e.g., via a synchronization command.

FIG. **6** is a block diagram illustrating an example system **190** that includes an external device, such as a server **204**, and one or more computing devices **210**A-**210**N (computing devices **210**), that are coupled to IMD **16** and programmer **24** shown in FIG. **1** via a network **202**. In this example, IMD **16** may use its telemetry module **88** to communicate with programmer **24** via a first wireless connection, and to communication with an access point **200** via a second wireless connection. In the example of FIG. **6**, access point **200**, programmer **24**, server **204**, and computing devices **210** are interconnected, and able to communicate with each other, through network **202**. In some cases, one or more of access point **200**, programmer **24**, server **204**, and computing devices **210** may be coupled to network **202** through one or more wireless connections. IMD **16**, programmer **24**, server **204**, and computing devices **210** may each comprise one or more processors, such as one or more microprocessors, DSPs, ASICs, FPGAs, programmable logic circuitry, or the like, that may perform various functions and operations, such as those described herein.

Access point **200** may comprise a device that connects to network **186** via any of a variety of connections, such as telephone dial-up, digital subscriber line (DSL), fiber optic, wireless, or cable modem connections. In other examples, access point **200** may be coupled to network **202** through different forms of connections, including wired or wireless connections. In some examples, access point **200** may be co-located with patient **14** and may comprise one or more programming units and/or computing devices (e.g., one or more monitoring units) that may perform various functions and operations described herein. For example, access point **200** may include a home-monitoring unit that is co-located with patient **14** and that may monitor the activity of IMD **16**.

In some examples, access point **200**, server **204**, or computing devices **210** may perform any of the various functions or operations described herein. For example, processor **208** of server **204** may compare user identity information received from a user to stored user account information and generate access control information corresponding to a matching user account. Processor **208** may also, upon generating the access control information, further apply the access control information to specify actions available to the user for managing stored information.

In some examples, any or all of programmer **24**, access point **200**, server **204**, or computing device **210** may perform additional actions, such as outputting (e.g., displaying) the information associated with the user account matching the user identity information inputted by the user or actions available to the user for managing stored information.

In some cases, server **204** may be configured to provide a secure storage site for data that has been collected from IMD **16** and/or programmer **24**. Network **202** may comprise a local area network, wide area network, or global network, such as the Internet. In some cases, programmer **24** or server **204** may assemble data in web pages or other documents for viewing by and trained professionals, such as clinicians, or by the patient, via viewing terminals associated with computing devices **210**. Server **204** may also display the web pages or documents using input/output device **206**. The illustrated system of FIG. **6** may be implemented, in some aspects, with general network technology and functionality similar to that provided by the Medtronic CareLink® Network developed by Medtronic, Inc., of Minneapolis, Minn.

FIGS. 7A-7C are flow diagrams illustrating an example method for controlling the management of stored data via multiple user accounts. The example method may be performed by processor **80** of IMD **16**, processor **140** or programmer **24**, a processor of another device, such as an external server **204** or computing device **210**, or any combination thereof. The information for implementing the user accounts and associated abilities to manage data, as well as the stored IMD data, may be stored in memory **82** of IMD **16**, memory **142** of programmer **24**, a memory of another device, such as an external server **204** or computing device **210**, or any combination thereof.

In FIG. 7A, a user of a programmer **24** interrogates IMD **16** (**250**). A processor determines whether the user is an authenticated user or a general user (**252**). In some examples, the processor determines whether the user is an authenticated user or a general user based on identity information entered by the user via programmer **24**. In some examples, the processor determines that the user is a general user when the user does not enter identity information. In some examples, the processor prompts the user to enter identity information when the user turns on or otherwise activates programmer **24** or interrogates IMD **14**. The identity information may comprise a user name and/or password, for example.

In one example, the processor retrieves user identity information corresponding to user accounts **108**. The processor compares the user-entered identity information, if any is entered, to the user identity information stored in the set of authenticable user accounts (e.g., **122**A to **122**N) and to the user identity information stored in general user account (e.g., **174**). If the entered user identity information matches one of the set of authenticable user accounts, the user is an authenticated. If the user identity information matches general user account **174**, or the user does not enter identity information, the user is an unauthenticated user, and the processor provides the functionality illustrated in FIG. 7C.

In one example, if the processor determines that the user is an authenticated user (**252**), the processor retrieves and/or displays diagnostic data **106**, programming history, and the current operational parameters **102** of IMD **16** according to the user-specific account (**254**). The data retrieved and/or presented for the user may depend on when the authorized user last communicated with IMD **16**, rather then the contents of the memory of IMD **16**. Thus, for example, the authorized user may view changes to operational parameters **102** made by another user, such as a general user, via programming history **104**, as well as diagnostic parameters **106**, even if the other user cleared the programming history **104** and diagnostic data **106** when interacting with the general user account **124**.

Accordingly, if another user, e.g., a general user, made changes to operational parameters **102** (**256**), programmer **24** displays a summary of the changes via programming history **104** (**258**). The authenticated user may review the changes and choose to accept the changes (**260**). If the user accepts the changes (**260**), the changes are synchronized across at least the authenticable user account associated with the authenticated user and general user account **124** and programming history **104** is updated to reflect the changes (**272**, FIG. 7B). In other examples, the changes may be synchronized across all of the authenticable user accounts **122**A to **122**N and **124**. If the authenticated user rejects the changes and chooses to rollback the changes (**262**), operational parameters **102** are restored to the state prior to the changes made by the unauthenticated user. The rollback may be synchronized to other user accounts with programming history **104** updated to reflect the rollback (**272**, FIG. 7C).

The authenticated user may also elect to make changes to operational parameters **102** independent of accepting or rejecting changes made by another user (**264**). If the authenticated user elects to make programming changes, programmer **24** receives the changes (**266**). The changes may be synchronized to other user accounts with programming history **104** updated to reflect the changes (**272**, FIG. 7B).

Referring to FIG. 7B, the authenticated user may also review and then clear diagnostic data **106**. If the authenticated user elects to clear diagnostic data **106** (**268**), diagnostic data **106** is cleared across at least the authenticable user account associated with the authenticated user and general user account **174** (**270**). In other examples discussed above, the diagnostic data may be cleared from all of the set of authenticable user accounts **122**A to **122**N and general user account **124**. If the authenticated user elects not to clear the diagnostic data, the session may end.

If the processor that the user is a general user (**252**), the processor retrieves and/or displays data according to the general user account (**280**, FIG. 7C). For example, the processor may display the current operational parameters **102** and any diagnostic data **106** not cleared from the general account. The unauthenticated user may clear diagnostic data **106** from general user account **124**, or make changes to the current operational parameters **102** (**282**). If the unauthenticated user chooses to clear diagnostic data **106**, diagnostic data **106** is cleared from being viewed by general user account **124**, but is not erased from memory **82** (**284**). In some examples, after diagnostic data **106** is cleared from general user account **124**, the set of authenticable user accounts **122**A to **122**N are notified that diagnostic data **106** was cleared by the unauthenticated user (**288**). Notification of the authenticable user or users may be storing an indication that the data was cleared in the account **122**, or by communication with a server **204** or computing device **210** via a network **202**. As examples, the authenticable user may receive the notification via the user interface **144** of programmer **24** the next time the authenticable user accesses programmer **24**, via an email or web account, via a cellular phone or personal digital assistant, or by fax.

If the unauthenticated user elects to make changes to the current operational parameters **102**, programming history **104** is updated to reflect the changes (**286**). In some example, after the programming changes are recorded in the current operational parameters **102** and programming history **104** is updated (**286**), the set of authenticable user accounts **122** receives notification of the programming changes made by the unauthenticated user (**288**). Notification may be provided in any of the manners described above.

In some examples, the processor may also provide a notification to an authorized user if an event is detected by interrogation of IMD **16** by a general user or another authorized user. The event may be a clinically significant event, such as tachyarrhythmia or heart failure decompensation. The event may be occurring during interrogation, or may have occurred at any time since the notified authenticable user last interrogated IMD **16** or otherwise accessed his or her account **122**. The event may be included as part of an event history **112** within diagnostic data **106**. In some examples, if the processor detects that event history **112** includes events not viewed by authenticable users (**282**), the processor provides one or more of the set of authenticable user accounts **122** notification of the events (**288**). The notification of an event may include, for example, an EGM and marker channel associated with the event.

Although FIG. 7C illustrates the processor either clearing diagnostic data, receiving programming changes, or detect-

ing an event prior to the processor ending, in some examples, the processor may perform any or all of these functions prior to the session with the general user ending. In some examples, after the authenticated or unauthenticated user has completed performing any or all of the above actions, programmer **24** may interrogate IMD **16** and store any changes made by the user to information stored in memory **142** of programmer **24** in memory **82** of IMD **16**.

As described above, any of or any combination of programs **102/152**, programming history **104/154**, diagnostic data **106/156** and/or user accounts **108/158** may be stored in memory **82** of IMD **16** or in memory **142** of programmer **24**. Any of the techniques described above may be implemented whether programs **102/152**, programming history **104/154**, diagnostic data **106/156** or user accounts **108/158** are stored in memory **82** of IMD **16** or in memory **142** of programmer **24**. Furthermore, processor **80** of IMD or processor **140** of programmer **24** may execute any of the computer-readable instructions which cause the actions describe above to occur.

The techniques described in this disclosure may be implemented, at least in part, in hardware, software, firmware, or any combination thereof. For example, various aspects of the described techniques may be implemented within one or more processors, including one or more microprocessors, digital signal processors (DSPs), application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), or any other equivalent integrated or discrete logic circuitry, as well as any combinations of such components. The term "processor" or "processing circuitry" may generally refer to any of the foregoing logic circuitry, alone or in combination with other logic circuitry, or any other equivalent circuitry. A control unit comprising hardware may also perform one or more of the techniques of this disclosure.

Such hardware, software, and firmware may be implemented within the same device or within separate devices to support the various operations and functions described in this disclosure. In addition, any of the described units, modules or components may be implemented together or separately as discrete but interoperable logic devices. Depiction of different features as modules or units is intended to highlight different functional aspects and does not necessarily imply that such modules or units must be realized by separate hardware or software components. Rather, functionality associated with one or more modules or units may be performed by separate hardware or software components, or integrated within common or separate hardware or software components.

The techniques described in this disclosure may also be embodied or encoded in a computer-readable medium, such as a computer-readable storage medium, containing instructions. Instructions embedded or encoded in a computer-readable medium may cause a programmable processor, or other processor, to perform the method, e.g., when the instructions are executed. Computer readable storage media may include random access memory (RAM), read only memory (ROM), programmable read only memory (PROM), erasable programmable read only memory (EPROM), electronically erasable programmable read only memory (EEPROM), flash memory, a hard disk, a CD-ROM, a floppy disk, a cassette, magnetic media, optical media, or other computer readable media.

Various examples have been described. These and other examples are within the scope of the following claims.

The invention claimed is:

1. A method comprising:

storing data of an implantable medical device and a set of user accounts in a memory, wherein the set of user accounts comprises a general user account and a user accounts;

determining whether a user of a programmer that communicates with the implantable medical device is a general user or an authenticable user;

accessing one of the general user account or one of the plurality of authenticable user accounts based on the determination, wherein the each of the accounts include respective access control information that specifies a respective subset of the data of the implantable medical device available and respective actions available for managing the data;

controlling access and management of the data of the implantable medical device by the user according to the access control information of the accessed one of the accounts;

during access and management of the data by an authenticable user associated with the one of the plurality of authenticable user accounts, receiving a request from the authenticable user associated with the one of the plurality of authenticable user accounts to clear data from the implantable medical device, wherein the data is accessible to both general users and each authenticable user associated with one of the plurality of authenticable user accounts; and

in response to receiving the request to clear data from the authenticable user, clearing the data from both the general user account and the one of the plurality of authenticable user accounts associated with the authenticable user, but not from any of the other authenticable user accounts of the plurality of authenticable user accounts,

wherein the data comprises diagnostic data, and

wherein the diagnostic data comprises at least one of physiological data of the patient collected by the implantable medical device or indications of therapy delivery by the implantable medical device.

2. The method of claim **1**, wherein determining whether the user is a general user or an authenticable user comprises: receiving, with the programmer, identity information for the user; and comparing the identity information for the user to information stored in the set of user accounts, and

wherein accessing one of the accounts comprises accessing the one of the accounts with stored identity information that matches the identity information received with the programmer.

3. The method of claim **1**, wherein determining whether the user is a general user or an authenticable user comprises determining that the user is a general user, wherein accessing one of the accounts comprises accessing the general user account, and wherein controlling the access and management of the data comprises: receiving a request from the general user accessing the general user account to clear data from the implantable medical device; and in response to receiving the request to clear data from the general user, clearing the data from the general user account, but not from any of the plurality of authenticable user accounts.

4. The method of claim **1**, wherein determining whether the user is a general user or an authenticable user comprises determining that the user is a general user, wherein accessing one of the accounts comprises accessing the general user account, and wherein controlling the access and management of the data comprises: receiving a request from the general

user accessing the general user account to change an operational parameter of the implantable medical device;

changing the operational parameter in response to the request; and updating a programming history accessible by the plurality of authenticable user accounts to indicate the changing of the operational parameter.

5. The method of claim **1**, wherein determining whether the user is a general user or an authenticable user comprises determining that the user is a general user,

wherein accessing one of the accounts comprises accessing the general user account, and

wherein controlling the access and management of the data comprises: receiving a request from the general user accessing the general user account to change the data; and

providing a notification to the plurality of authenticable user accounts that the data was changed for the general user account.

6. The method of claim **1**, further comprising: during access and management of the data via another of the accounts, determining that an event has occurred since the data was last accessed and managed by at least one of the plurality of authenticable user accounts; and

notifying the authenticable user account of the event in response to the determination.

7. The method of claim **1**, wherein determining whether the user is a general user or an authenticable user comprises determining that the user is an authenticable user,

wherein accessing one of the accounts comprises accessing the one of the plurality of authenticable user accounts associated with the authenticable user, and

wherein controlling the access and management of the data comprises synchronizing changes to the data made by the authenticable user across the one of the set of authenticable user accounts and the general user account.

8. The method of claim **7**, further comprising synchronizing the changes across others of the plurality of authenticable user accounts.

9. The method of claim **1**, wherein determining whether the user is a general user or an authenticable user comprises determining that the user is an authenticable user, wherein accessing one of the accounts comprises accessing the one of the plurality of authenticable user accounts associated with the authenticable user, and wherein controlling the access and management of the data comprises displaying a programming history illustrating a change made to an operational parameter of the implantable medical device since the last time the authenticable user accessed the account.

10. The method of claim **9**, further comprising: receiving a request from the authenticable user to undo the change; and

setting the operational parameter to a value prior to the change in response to the request.

11. The method of claim **1**, wherein the memory comprises a memory of the implantable medical device.

12. The method of claim **1**, wherein the data comprises operational parameters of the implantable medical device.

13. The method of claim **1**,

wherein determining whether the user is the general user or the authenticable user comprises determining whether the user is the general user or the authenticable user based upon identity information for the user, and

wherein the user is the general user if the user does not enter identity information.

14. A system comprising:

an implantable medical device;

a programmer that communicates with the implantable medical device,

a memory that stores data of the implantable medical device and a set of user accounts, wherein the set of user accounts comprises a general user account and a plurality of authenticable user accounts; and

a processor that determines whether a user of the programmer is a general user or an authenticable user, accesses one of the general user account or one of the plurality of authenticable user accounts in the memory based on the determination,

wherein the each of the accounts include respective access control information that specifies a respective subset of the data of the implantable medical device available and respective actions available for managing the data, and controls access and management of the data of the implantable medical device by the user according to the access control information of the accessed one of the accounts,

wherein, during access and management of the data by an authenticable user associated with the one of the plurality of authenticable user accounts, the processor is configured to receive a request from the authenticable user associated with the one of the plurality of authenticable user accounts to clear data from the implantable medical device, wherein the data is accessible to both general users and each authenticable user associated with one of the plurality of authenticable user accounts, and in response to receiving the request to clear data from the authenticable user, clear the data from both the general user account and the one of the plurality of authenticable user accounts associated with the authenticable user, but not from any of the other authenticable user accounts of the plurality of authenticable user accounts,

wherein the data comprises diagnostic data, and

wherein the diagnostic data comprises at least one of physiological data of the patient collected by the implantable medical device or indications of therapy delivery by the implantable medical device.

15. The system of claim **14**, wherein the programmer receives identity information for the user, and wherein the processor compares the identity information for the user to information stored in the set of user accounts, and accesses the one of the accounts with stored identity information that matches the identity information received by the programmer.

16. The system of claim **14**, wherein when the processor determines that the user is a general user, accesses the general user account, and receives a request from the general user accessing the general user account to clear data from the implantable medical device, the processor clears the data from the general user account but not from any of the plurality of authenticable user accounts.

17. The system of claim **14**, wherein when the processor determines that the user is a general user, accesses the general user account, and receives a request from the general user accessing the general user account to change an operational parameter of the implantable medical device, the processor changes the operational parameter in response to the request, and updates a programming history accessible by the plurality of authenticable user accounts to indicate the changing of the operational parameter.

18. The system of claim **14**, wherein when the processor determines that the user is a general user, accesses the general user account, and receives a request from the general user accessing the general user account to change the data, the processor provides a notification to the plurality of authenticable user accounts that the data was changed for the general user account.

19. The system of claim 14, wherein the processor determines that an event has occurred since the data was last accessed and managed by at least one of the plurality of authenticable user accounts during access and management of the data via another of the accounts, and notifies the authenticable user account of the event in response to the determination.

20. The system of claim 14, wherein when the processor determines that the user is an authenticable user and accesses one of the plurality of authenticable user accounts associated with the authenticable user, the processor synchronizes changes to the data made by the authenticable user across the one of the plurality of authenticable user accounts and the general user account.

21. The system of claim 20, wherein the processor synchronizes the changes across others of the plurality of authenticable user accounts.

22. The system of claim 14, wherein when the processor determines that the user is an authenticable user and accesses one of the plurality of authenticable user accounts associated with the authenticable user, the processor displays a programming history illustrating a change made to an operational parameter of the implantable medical device since the last time the authenticable user accessed the account.

23. The system of claim 22, wherein the processor receives a request from the authenticable user to undo the change, and sets the operational parameter to a value prior to the change in response to the request.

24. The system of claim 14, wherein the memory comprises a memory of the implantable medical device.

25. The system of claim 14, wherein the processor comprises a processor of the programmer.

26. The system of claim 14, wherein the data comprises operational parameters of the implantable medical device.

27. A system comprising:

means for storing data of an implantable medical device and a set of user accounts in a memory, wherein the set of user accounts comprises a general user account and a plurality of authenticable user accounts;

means for determining whether a user of a programmer that communicates with the implantable medical device is a general user or an authenticable user;

means for accessing one of the general user account or one of the plurality of authenticable user accounts based on the determination, wherein the each of the accounts include respective access control information that specifies a respective subset of the data of the implantable medical device available and respective actions available for managing the data;

means for controlling access and management of the data of the implantable medical device by the user according to the access control information of the accessed one of the accounts;

means for receiving a request, during access and management of the data by an authenticable user associated with the one of the plurality of authenticable user accounts, from the authenticable user associated with the one of the plurality of authenticable user accounts to clear data from the implantable medical device, wherein the data is accessible to both general users and each authenticable user associated with one of the plurality of authenticable user accounts; and

means for, in response to receiving the request to clear data from the authenticable user, clearing the data from both the general user account and the one of the plurality of authenticable user accounts associated with the authenticable user, but not from any of the other authenticable user accounts of the plurality of authenticable user accounts,

wherein the data comprises diagnostic data, and

wherein the diagnostic data comprises at least one of physiological data of the patient collected by the implantable medical device or indications of therapy delivery by the implantable medical device.

28. A non-transitory computer-readable storage medium comprising instructions that cause a programmable processor to:

access data of an implantable medical device and a set of user accounts, wherein the set of user accounts comprises a general user account and a plurality of authenticable user accounts;

determine whether a user of a programmer that communicates with the implantable medical device is a general user or an authenticable user;

access one of the general user account or one of the plurality of authenticable user accounts based on the determination, wherein the each of the accounts include respective access control information that specifies a respective subset of the data of the implantable medical device available and respective actions available for managing the data; and

control access and management of the data of the implantable medical device by the user according to the access control information of the accessed one of the accounts;

during access and management of the data by an authenticable user associated with the one of the set of authenticable user accounts, receive a request from the authenticable user associated with the one of the plurality of authenticable user accounts to clear data from the implantable medical device, wherein the data is accessible to both general users and each authenticable user associated with one of the plurality of authenticable user accounts; and

in response to receiving the request to clear data from the authenticable user, clear the data from both the general user account and the one of the plurality of authenticable user accounts associated with the authenticable user, but not from any of the other authenticable user accounts of the plurality of authenticable user accounts,

wherein the data comprises diagnostic data, and

wherein the diagnostic data comprises at least one of physiological data of the patient collected by the implantable medical device or indications of therapy delivery by the implantable medical device.

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